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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte DEOK-KEE KIM, RAMACHANDRA DIVAKARUNI,
HIROYUKI AKATSU, GEORGE WORTH,
JAY STRANE, and BYEONG KIM

Appeal 2008-5871
Application 10/710,566
Technology Center 2800

Decided: ¹ February 26, 2009

Before TERRY J. OWENS, MARK NAGUMO, and
KAREN M. HASTINGS, *Administrative Patent Judges*.

HASTINGS, *Administrative Patent Judge*.

DECISION ON APPEAL

¹ The two-month time period for filing an appeal or commencing a civil action, as recited in 37 CFR § 1.304, begins to run from the decided date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery).

International Business Machines Corporation (hereinafter, IBM; named as the real party in interest, App. Br. 3) appeals under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 1-20. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM-IN-PART.

STATEMENT OF THE CASE

The invention relates to a method of manufacture of an integrated circuit, as well as a method of planarizing a surface of a body of material (e.g., an integrated circuit). (Spec., ¶ [0001]).

Claims 1 and 16 are illustrative of the subject matter on appeal:

1. A method for manufacture of an integrated circuit having structures formed in respective first and second areas thereon, said method comprising steps of

reducing height of structures in said first and second areas to control step height in said first and second areas,

removing a material from said first and second areas simultaneously or sequentially, and replacing said material removed from said first and second areas with a first material in said first area and a second material in said second area, respectively, one of said first and second materials being an isolation material,

using a polysilicon block-out mask or a block-out mask having two layers of different materials to protect one of said first and second areas to separately process the other of said first and second areas,

planarizing said first and second materials to provide a planar surface, and completing said integrated circuit.

16. A method for planarizing a surface of a body of material, said method including steps of

applying a planarizing material to said body of material to form a substantially planar surface, and

performing a non-selective etching from said substantially planar surface to a point on or within said body of material.

The Examiner relies on the following prior art references to show unpatentability:

Hummler	US 6,620,677	Sep. 16, 2003
Gustafson	US 6,837,965	Jan. 4, 2005

The Examiner has rejected claims 1-4, 7-12, and 14-20 under 35 U.S.C. § 102(e) as being anticipated by Hummler; claims 5-6 under 35 U.S.C. § 103(a) as unpatentable over Hummler; and claim 13 under 35 U.S.C. § 103(a) as unpatentable over Hummler in view of Gustafson.

The § 102 Rejection based on Hummler

ISSUES ON APPEAL

The issues on appeal arising from the contentions of IBM and the Examiner regarding the first ground of rejection are: has IBM shown that the Examiner reversibly erred in establishing a prima facie case of anticipation of claims 1-4, 7-12, and 14-20; specifically;

a) that the method of Hummler does not “reduc[es] height of structures . . . to control step height” as required in claim 1;

b) that the method of Hummler does not “non-selectively” etch planarizing material as required by dependent claim 11 (which depends from claim 1), as well as by independent claims 12 and 16;

c) that the method of Hummler does not describe for “equalizing heights of structure in said first and second areas by etching” as required by dependent claim 8, and similarly “etching . . . structures of a second average height to an average height substantially equal to a first average height” as required by dependent claim 14; and

d) that the method of Hummler does not describe planarizing a surface in combination with a top oxide nitride process, or a top oxide late process as respectively required by dependent claims 18 and 19.

We answer this question in the negative with respect to issues (a) and (b), and in the affirmative with respect to issues (c) and (d).

PRINCIPLES OF LAW

“To anticipate a claim, a prior art reference must disclose every limitation of the claimed invention, either explicitly or inherently.” *In re Schreiber*, 128 F.3d 1473, 1477 (Fed. Cir. 1997)

However, the law of anticipation does not require that the reference ‘teach’ what the subject patent teaches. Assuming that a reference is properly ‘prior art,’ it is only necessary that the claims under attack, as construed, ‘read on’ something disclosed in the reference, i.e., all limitations of the claim are found in the reference, or ‘fully met’ by it. *See Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 772 (Fed. Cir. 1983).

It is axiomatic that during examination proceedings, claims are given their broadest reasonable interpretation consistent with the specification. *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004). Although claims are to be interpreted in light of the specification, limitations from the specification are not to be read into the claims. *See In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

The transitional term “comprising” is “inclusive or open-ended and does not exclude additional, unrecited elements or method steps.” *In re Baxter*, 656 F.2d 679, 686–87, 210 USPQ 795, 802–03 (CCPA 1981) (“as long as one of the monomers in the reaction is propylene, any other monomer may be present, because the term ‘comprising’ permits the inclusion of other steps, elements, or materials.”)

Method steps are not ordinarily construed to require an order unless they expressly or implicitly require performance in that order. *See, Altiris Inc. v. Symantec Corp.*, 318 F.3d 1363, 1371 (Fed. Cir. 2003).

FINDINGS OF FACTS

Findings of fact (FF) throughout this decision are supported by a preponderance of the evidence. Additional findings of fact as necessary appear in the Analysis portion of the opinion.

The term “step height” is critical in the following analysis. As stated in IBM’s Specification, “[t]he term ‘step height’ refers to the height above the silicon substrate level and is determined by the IT [isolation trench] height above silicon, pad nitride thickness, nitride liner thickness, the remaining hard mask thickness and stud height in the array” (Spec. 8, para. [0050]).

As found by the Examiner, Hummler discloses a method for manufacture of an integrated circuit (col. 1, ll. 15-17; see also Figs. 1-11 which illustrate the manufacturing steps) having structures formed in a respective first area (array region 16) and second area (support region 18), said method comprising steps of:

reducing height of structures in the first area 16 (e.g., insulating material 46 in Fig. 7A reduced by etching to leave spacer 48 in Fig. 8; and/or pad nitride 14 in Fig. 5A reduced via removal as depicted in Fig. 6A) and the second area 18 (isolation trench material 39 in Fig. 1A reduced via etching to line 40 as shown in Fig. 2A; also, mask 44 in second area of Fig. 7A is removed as depicted in Fig. 8) to control step height in said first and second areas (that is, reducing height of these structures necessarily “control[s] step height”);

removing a material (insulating material 46 in Fig 7A is removed as seen in Fig. 8) from said first and second areas “simultaneously” (col. 6, ll. 52-54; col. 5, l. 50), and replacing said material removed from said first and second areas with a first material (insulating material 50) in said first area and a second material (also “reads on” insulating material 50) in said second area, one of said first and second materials being an isolation material (see, e.g., Fig. 9; col. 6, ll. 66-67; insulating material 50 “reads on” an isolation material);

using a polysilicon block-out mask to protect said second area to separately process the first area (Figs. 4, 5: mask 44; col. 6, ll. 17-21 and ll. 26-35);

planarizing (col. 7, ll. 5-9) said first and second materials to provide a planar surface (e.g., top surface in Fig. 10A); and

completing said integrated circuit (Fig. 11, col. 7, ll. 54-55).

According to IBM’s definition of “step height”, any reduction in height or thickness of the above listed structures in the first and second areas of Hummler meets “reducing height of structures . . . to control step height” as recited in claim 1.

Hummler describes reducing the height of the isolation trenches 38, reducing the hard mask thickness (e.g., mask 44), as well as reducing the height/thickness of the nitride pad 14 and nitride liner 42 (see, e.g. col. 5, ll. 48-65, col. 6, l. 1 to col. 7, l. 17).

Accordingly, the steps recited in claim 1 “read on” Hummler’s process steps as outlined above.

ANALYSIS

Issue a

Appellants do not separately argue claims 1, 2, 7, 9, and 10 (App. Br. 22-25, Reply Br. 1-5). Accordingly, we select independent claim 1 as representative of this claim grouping.

We are in agreement with the Examiner that the method of Hummler is substantially identical to the claimed process as recited in claim 1 under 35 U.S.C. § 102 (see, e.g., Ans. 4-7; FF above).

IBM’s main argument is that Hummler “is silent as to control of step height” (App. Br. 23) and that the Examiner gave “no patentable weight to claim recitations which distinguish the improved features of the invention from those of Hummler” (Reply Br. 5); although as even IBM states, these differences “are, perhaps, subtle” (*id.*).² Specifically, with respect to

² IBM’s comments regarding the guidance with respect to “adapted to”, “whereby”, and “wherein” clauses in MPEP 2111.04 are not on point (Reply Br. 2-4). The Examiner stated the “recited purpose [i.e., to control step height] does not further limit claim [1] since it does not require additional non-recited steps [to be performed]; . . . *reducing height necessarily controls step height*” (Ans. 4; emphasis added; compare to first sentence of MPEP 2111.04 which provides guidance for claim language that does **not** limit claim scope, *in contrast* to the questionable limiting effect of the specific “adapted to”, etc., clauses).

independent claim 1, IBM's only argument is that since Hummler "is silent as to the control of step height", Hummler does not anticipate claim 1 (App. Br. 23). We disagree.

IBM does not support its arguments with evidence from Hummler or the Record. Indeed, Hummler's process reduces height of structures in the first memory array area and in the second support area that IBM describes in their Specification as structures that determine the step height. That is, reducing height of the structures as set forth in the FF above necessarily "control[s] step height" as recited in claim 1. Thus, Hummler's process reasonably meets the "control [of] step height" limitation recited in claim 1.

IBM has not directed us to any persuasive reasoning or evidence sufficient to refute the Examiner's finding the process of Hummler anticipates claim 1. Accordingly, Appellants have not shown that the Examiner reversibly erred in finding that the method of Hummler "control[s] step height".

Therefore, we agree with the Examiner that claim 1 is anticipated by Hummler.

Claims 3 and 4

IBM contends that Hummler does not anticipate the subject matter of claims 3 and 4 because Hummler only teaches the use of a polysilicon hard mask with a nitride liner (App. Br. 24). This is not persuasive of reversible error in the Examiner's rejection. Claims 3 and 4 use open-ended language (e.g., "comprises"), which permits the inclusion of other unrecited elements, such as the nitride liner described by Hummler together with the polysilicon hard mask.

Issue b

Claims 11, 12, 16

ADDITIONAL PRINCIPLES OF LAW

Where the Examiner establishes a reasonable belief that the property or characteristic recited in the claims would have been inherent to the product or process, the burden of proof shifts to Appellants to show that this characteristic or property is not possessed by the prior art. *In re Spada*, 911 F.2d 705, 708, (Fed. Cir. 1990); *In re Best*, 562 F.2d 1252, 1254-55 (CCPA 1977).

Appellants' attorney's arguments do not take the place of evidence in the record. *In re Pearson*, 494 F.2d 1399, 1405 (CCPA 1974).

It is well established that drawings can be relied upon for what they reasonably disclose and suggest to one of ordinary skill in the art. *See In re Mraz*, 455 F.2d 1069, 1072 (CCPA 1972); *In re Aslanian*, 590 F.2d 911, 914 (CCPA 1979).

It is well established that a prior art patent is presumed to be enabling, and that the burden is upon Appellants to provide facts rebutting this presumption. *Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1355 (Fed. Cir. 2003) ("[W]e hold a presumption arises that both the claimed and unclaimed disclosures in a prior art patent are enabled."); *see also Chester v. Miller*, 906 F.2d 1574, 1578 (Fed. Cir. 1990); *In re Sasse*, 629 F.2d 675, 681 (CCPA 1980).

ADDITIONAL FINDINGS OF FACT

Dependent claim 11, and each of independent claims 12 and 16, recite that "non-selective" etching is performed after applying a planarizing material.

“Non-selective” etching is defined by IBM as one wherein the etching proceeds at approximately the same rate in the materials which will be presented, that is, if a heterogenous planar substrate is etched, a substantially planar surface is achieved (Spec. 8, para. [0053]).

Hummler describes applying a planarizing material (e.g., an anti-reflective coating) followed by a reactive ion etch (RIE) to obtain a substantially planar surface (col. 7, ll. 3-9; see also Fig. 9 before and Fig. 10A after the RIE).

IBM’s Specification likewise describes applying an anti-reflective coating (as the planarizing material) followed by a RIE (Spec. 8, para. [0053]).

According to IBM, “[i]n modern integrated circuits and for an array top oxide structure, in particular, good uniformity and planarity within a tolerance of 15 nm is generally required” (Spec. 1, para. [0008]).

None of IBM’s claims are limited to any particular tolerance for the planarity.

ANALYSIS

IBM contends that Hummler does not anticipate dependent claim 11, nor independent claims 12 and 16, because Hummler does not mention that the etch is “non-selective” as recited therein, or that a substantially planar surface is sought as a result of the etching process (App. Br. 24, 25). Appellants also contend there is no enabling disclosure in Hummler for a non-selective etching (*id.*).

These arguments are not persuasive. One of ordinary skill in the art would have immediately recognized that a substantially uniform planar

surface is desired in Hummler via the substantially planar surface depicted in Fig. 10A (see FF above). Accordingly, the Examiner's position that the reactive ion etch (RIE) of Hummler is "non-selective" (that is, that the RIE process of Hummler is described, via the figures in combination with the text, as "non-selective") is reasonable.

IBM has offered no credible argument nor evidence that the RIE of Hummler is "selective" as to certain materials shown in Fig. 9 versus "non-selective". To the contrary, Fig. 10 illustrates that the nitride layer 42, as well as the insulating material 50, and the pad nitride 14, are all removed in the RIE to present a substantially uniform planar surface in Fig. 10A.

IBM's remarks regarding the alleged non-enabling disclosure of Hummler are not well taken. Hummler is presumed to be enabling for all that it describes and IBM has proffered no evidence to the contrary. *See, In re Sasse*, 629 F.2d at 681.

Accordingly, IBM has not shown that the Examiner reversibly erred in finding that the method of Hummler includes a "non-selective etching" as required by claims 11, 12, and 16.

Dependent claims 15 and 17 (which depend from independent claims 12 and 16, respectively)

With respect to claim 15, Appellants have not disputed the Examiner's finding that Hummler describes the removal of nitride liner 42 by the non-selective etching step (see, e.g., Fig. 9, col. 7, l. 7; Ans. 7; App. Br. and Reply Br., generally). Likewise, Appellants have not disputed that Hummler describes a top oxide early process as recited in claim 17.

Accordingly, IBM has not shown reversible error in the Examiner's determination that claims 15 and 17 are anticipated by Hummler.

Issue c

Claims 8 and 14

We agree with IBM that Hummler does not anticipate these claims (App. Br. 24, 26).

Claim 8 (which depends from independent claim 1) requires "the further step of *equalizing heights* of structures in said first and second areas *by etching* prior to [the] planarizing step" (emphasis added). Similarly, claim 14 (which depends from independent claim 12) requires "etching said structures of said second average height to an average height substantially equal to said first average height" prior to the planarizing and non-selective etching steps. As pointed out by IBM, this embodiment of the invention as reflected in claims 8 and 14 avoids the problems of an excess of planarizing material near the boundaries of areas of increased height (App. Br. 10).

The Examiner alleges that Hummler discloses these steps but does not rely upon any specific disclosure in Hummler in support thereof (see, e.g., Ans. 5, 6). In the Response to Argument section, the Examiner relies upon Fig. 9 of Hummler and states that "structure 34 . . . is approximately the

same height as structure 14 . . .; *average* height of structure 48 and 34 in first area 16 is approximately the same height as structure 38” (Ans. 11). The deficiency of this reasoning is that the Examiner has not provided any rationale supported by the disclosure in Hummler that the heights of these structures were equalized, nor that they were equalized by “etching”.

Accordingly, we are constrained to reverse the 102 rejection of claims 8 and 14 based on Hummler.

Claim 20 which depends from independent claim 16

In contrast to claims 8 and 14 discussed above, claim 20 merely requires “adjusting height of a structure on a differentiated area of said body of material.” Hummler describes adjusting heights of various structures on the integrated circuit device (e.g., “isolation trenches 38 are etched back to a height equal to approximately half the thickness of pad nitride 14”; see col. 5, ll. 57-60), and is thus reasonably encompassed by the broad language of claim 20.

Issue d

Claims 18 and 19 which depend from independent claim 16

We agree with IBM that Hummler is limited to an exemplary top oxide early (TOE) process, and thus does not anticipate these claims which are drawn to a top oxide nitride (TON) process or a top oxide late (TOL) process (App. Br. 25).

The Examiner’s position is that Hummler encompasses all three processes since Hummler states the order of steps may be rearranged (col. 8, ll. 19-20; Ans. 12). However, many different process steps are described in Hummler that may be rearranged within the context of the TOE process described therein. Hummler describes the rearrangement of process steps

solely within the context of the TOE process described in detail at column 4, line 26 to column 7, line 58. Significantly, Hummler distinguishes these three different processes (TOE, TON, and TOL) (col. 3, l. 40 to col. 4, l. 25) and then states “The present invention comprises a TOE process . . .” (col. 4, ll. 25-30). Accordingly, we agree with IBM that the invention described in Hummler is described only with respect to a TOE process.

We are constrained by these circumstances to reverse the § 102 rejection of claims 18 and 19 based on Hummler.

Additional Issues

The § 103 Rejection of claims 5 and 6

ADDITIONAL PRINCIPLES OF LAW

“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007). The question to be asked is “whether the improvement is more than the predictable use of prior art elements according to their established functions.” *KSR*, 127 S. Ct. at 1740.

ANALYSIS

with Factual Findings

Claim 5 recites that “a polysilicon hard mask is used to mask said first area”; claim 6 further recites that this mask “comprises a single layer of polysilicon”.

The Examiner’s position is that since Hummler describes that the first area is not processed during processing of the second area, and that a polysilicon hard mask may be used to mask the second area during processing, the use of a polysilicon mask to mask the first area during

processing of the second area would have likewise been within the level of ordinary skill in the art and therefore would have been obvious (Ans. 7 and 8).

IBM contends that the Examiner has failed to provide a “compelling line of reasoning” that the use of a polysilicon mask would have been obvious (App. Br. 28). We disagree. The use of a polysilicon mask appears to be no more than the predictable use of a known mask for its known function. *See KSR*, 127 S. Ct. at 1740.

IBM’s further contention that Hummler only describes the use of the polysilicon mask in combination with a nitride (App. Br. 28) is of little moment, since claims 5 and 6 are open to the presence of additional unrecited components. In addition, the claim language fails to distinguish over Hummler’s description of the alternative use of the polysilicon mask 44 to mask a first area, as well as a second area (see, col. 6, ll. 18-25; Fig. 4).

Accordingly, IBM has failed to show reversible error in the Examiner’s determination that claims 5 and 6 are unpatentable as obvious based on Hummler.

The § 103 Rejection of claim 13 based on Hummler and Gustafson

Claim 13 depends from independent claim 12 and recites “performing end point detection” for determining termination of the non-selective etching process recited in claim 12.

The Examiner relied upon Gustafson as exemplifying that end-point detection was well known in the etching art and accordingly would have been obvious to perform in the etching process of Hummler (Ans. 8).

IBM concedes that end-point detection for control of etching process is known (Ans. 29); yet argues that the use of the specific end-point

detection technique of Gustafson would be counter intuitive for a non-selective etching process where many different reaction products may be concurrently generated (*id.*).

However, the Examiner did not rely upon the specific end-point detection technique disclosed as “the invention” of Gustafson; rather, he relied upon the discussion of admitted prior art end point detection techniques in the “Description of Related Art” section of Gustafson (Ans. 8; Gustafson col. 1, ll. 24- 31). Gustafson discussed optical spectrometry as one known end point detection technique (col. 1, ll. 48-50). Furthermore, IBM admits that “[n]umerous [end-point detection] techniques . . . are known and are also suitable” for use in the present invention, including optical spectroscopy (Spec. 8, para. [0052]). It is well established that “[a] statement in a patent that something is in the prior art is binding on the applicant and patentee for determinations of anticipation and obviousness.” *See Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1570 (Fed. Cir. 1988) ; see also *In re Nomiya*, 509 F.2d 566, 571 n.5 (CCPA 1975) (It is a "basic proposition that a statement by an applicant, whether in the application or in other papers submitted during prosecution, that certain matter is 'prior art' to him, is an admission that that matter is prior art for all purposes . . .").

Thus, the use of an appropriate known end-point detection technique, such as optical spectroscopy as discussed in Gustafson, would have been no more than a predictable use of an admittedly known process for its predictable result.

Accordingly, IBM has not shown that the Examiner reversibly erred in determining that claim 13 is unpatentable over the combined teachings of Hummler and Gustafson.

ORDER

The Examiner's rejection of claims 1-4, 7, 9-12, and 15-17, and 20 under 35 U.S.C. § 102(e) as being anticipated over Hummler is affirmed.

The Examiner's rejection of claims 8, 14, 18, and 19 under 35 U.S.C. § 102(e) as being anticipated over Hummler is reversed.

The Examiner's rejection of claims 5 and 6 under 35 U.S.C. § 103 as being unpatentable over Hummler is affirmed.

The Examiner's rejection of claim 13 under 35 U.S.C. § 103 as being unpatentable over Hummler and Gustafson is affirmed.

The Examiner's decision is affirmed-in-part.

No time period for taking any subsequent action in connection with this appeal maybe extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART

PL Initial:
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